

**WE CLAIM:**

- 1           1.       A tubular structure having an aspect ratio of about 3 or more and  
2       comprising an interior surface, said interior surface comprising a gaseous deposition  
3       product comprising a substantially uniform coating.
- 1           2.       The tubular structure of claim 1 wherein said coating comprises a  
2       thickness of at least about 0.5 micrometers.
- 1           3.       The tubular structure of claim 1 wherein said coating comprises a  
2       thickness of at least about 2 micrometers or more.
- 1           4.       The tubular structure of claim 1 wherein said coating comprises a  
2       thickness of at least about 5 micrometers or more.
- 1           5.       The tubular structure of claim 1 wherein said coating comprises a  
2       thickness of at least about 15 micrometers or more.
- 1           6.       The tubular structure of claim 1 wherein said gaseous deposition  
2       product gaseous comprises carbon.
- 1           7.       The tubular structure of claim 1 wherein said gaseous deposition  
2       product comprises silicon.
- 1           8.       The tubular structure of claim 1 wherein said gaseous deposition  
2       product comprises chromium.
- 1           9.       The tubular structure of claim 1 wherein said gaseous deposition  
2       product comprises aluminum.
- 1           10.      The tubular structure of claim 1 wherein said gaseous deposition  
2       product comprises titanium.
- 1           11.      The tubular structure of claim 1 wherein a gaseous precursor material  
2       for said gaseous deposition product comprises a diffusion pump fluid selected from

3 the group consisting of polyphenyl ether; elcosyl naphthalene; *i*-diamyl phthalate; *i*-  
4 diamyl sebacate; chlorinated hydrocarbons; *n*-dibutyl phthalate; *n*-dibutyl sebacate; 2-  
5 ethyl hexyl sebacate; 2-ethyl hexyl phthalate; di-2-ethyl-hexyl sebacate; tri-*m*-cresyl  
6 phosphate; tri-*p*-cresyl phosphate; and o-dibenzyl sebacate.

1 12. The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises siloxane.

1 13. The tubular structure of claim 12 wherein said siloxane is polydimethyl  
2 siloxane.

1 14. The tubular structure of claim 12 wherein said siloxane is pentaphenyl-  
2 trimethyl siloxane.

1 15. The tubular structure of claim 12 wherein a gaseous precursor material  
2 for said siloxane is a silicon containing diffusion pump fluid.

1 16. The tubular structure of claim 1 wherein a gaseous precursor material  
2 for said gaseous deposition product comprises a metallic precursor.

1 17. The tubular structure of claim 16 wherein said metallic precursor is  
2 selected from the group consisting of metal carbonyls, metal acetates, and metal  
3 alkanedionates.

1 18. The tubular structure of claim 17 wherein said metallic precursor is  
2 metal pentanedionate.

1 19. The tubular structure of claim 17 wherein said metallic precursor is  
2 selected from the group consisting of tetrakis(dimethylamino)titanium,  
3 hexacarbonylchromium, and hexacarbonylvandium carbonyl.

1 20. The tubular structure of claim 19 wherein said hexacarbonylvandium  
2 carbonyl is selected from the group consisting of erbium III acetate, yttrium 2,4-

3 pentanedionate, erbium 2,4-pentanedionate, and N,N-(dimethylethanamine)-  
4 trihydridoaluminum.

1 21. The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises silane.

1 22. The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises trimethyl silane.

1 23. The tubular structure of claim 1 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1 24. The tubular structure of claim 2 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1 25. The tubular structure of claim 3 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1 26. The tubular structure of claim 4 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1 27. The tubular structure of claim 5 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1 28. A tubular structure having an aspect ratio of about 3 or more and  
2 comprising an interior surface, said interior surface comprising a gaseous deposition  
3 product comprising a substantially uniform amorphous carbon coating.

1           29.    The tubular structure of claim 28 wherein said coating comprises a  
2 thickness of at least about 0.5 micrometers.

1           30.    The tubular structure of claim 28 wherein said coating comprises a  
2 thickness of at least about 2 micrometers or more.

1           31.    The tubular structure of claim 28 wherein said coating comprises a  
2 thickness of at least about 5 micrometers or more.

1           32.    The tubular structure of claim 28 wherein said coating comprises a  
2 thickness of at least about 15 micrometers or more.

1           33.    The tubular structure of claim 29 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1           34.    The tubular structure of claim 30 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1           35.    The tubular structure of claim 31 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1           36.    The tubular structure of claim 32 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1           37.    The tubular structure of claim 29 wherein said coating comprises a  
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           38.    The tubular structure of claim 30 wherein said coating comprises a  
2 nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

- 1           39.     The tubular structure of claim 31 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.
- 1           40.     The tubular structure of claim 32 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.
- 1           41.     The tubular structure of claim 29 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.
- 1           42.     The tubular structure of claim 30 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.
- 1           43.     The tubular structure of claim 31 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.
- 1           44.     The tubular structure of claim 32 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.
- 1           45.     A tubular structure having an aspect ratio of about 6 or more and  
2     comprising an interior surface, said interior surface comprising a gaseous deposition  
3     product comprising a substantially uniform amorphous carbon coating.
- 1           46.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 0.5 micrometers.
- 1           47.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 2 micrometers.
- 1           48.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 5 micrometers.
- 1           49.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 15 micrometers.

1           50.     The tubular structure of claim 46 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           51.     The tubular structure of claim 47 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           52.     The tubular structure of claim 48 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           53.     The tubular structure of claim 49 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           54.     The tubular structure of claim 46 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           55.     The tubular structure of claim 47 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           56.     The tubular structure of claim 48 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           57.     The tubular structure of claim 49 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           58.     The tubular structure of claim 46 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           59.     The tubular structure of claim 47 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           60.    The tubular structure of claim 48 wherein said coating comprises a  
2   hydrogen concentration of about 32 %.

1           61.    The tubular structure of claim 49 wherein said coating comprises a  
2   hydrogen concentration of about 32 %.

1           62.    The tubular structure of claim 45 comprising said interior surface  
2   comprising at least one metal, and comprising a sequential gradient towards a center  
3   of said tubular structure comprising:

4           silicon chemically bonded to said metal, forming a metal-silicide;  
5           silicon cohesively bonded to said metal-silicide;  
6           carbon chemically bonded to said silicon, forming silicon-carbide; and  
7           carbon cohesively bonded to said silicon-carbide forming said substantially  
8           uniform carbon coating.

1           63.    The tubular structure of claim 45 comprising said interior surface  
2   comprising at least one metal, and comprising a sequential gradient towards a center  
3   of said tubular structure comprising:

4           germanium chemically bonded to said metal, forming a metal-germanide;  
5           germanium cohesively bonded to said metal-germanide;  
6           carbon chemically bonded to said germanium, forming germanium -carbide;  
7   and

8           carbon cohesively bonded to said germanium -carbide forming said  
9           substantially uniform carbon coating.

1           64.    The tubular structure of claim 62 wherein said coating has a thickness  
2   of at least about 0.5 micrometers.

- 1           65.    The tubular structure of claim 62 wherein said coating has a thickness  
2   of at least about 2 micrometers or more.
- 1           66.    The tubular structure of claim 62 wherein said coating has a thickness  
2   of at least about 5 micrometers or more.
- 1           67.    The tubular structure of claim 62 wherein said coating has a thickness  
2   of at least about 15 micrometers or more.
- 1           68.    The tubular structure of claim 62 wherein said gaseous deposition  
2   product comprises carbon.
- 1           69.    The tubular structure of claim 62 wherein said gaseous deposition  
2   product comprises silicon.
- 1           70.    The tubular structure of claim 62 wherein said gaseous deposition  
2   product comprises chromium.
- 1           71.    The tubular structure of claim 62 wherein said gaseous deposition  
2   product comprises aluminum.
- 1           72.    The tubular structure of claim 62 wherein said gaseous deposition  
2   product comprises titanium.
- 1           73.    The tubular structure of claim 62 wherein a gaseous precursor to said  
2   gaseous deposition product comprises a diffusion pump fluid selected from the group  
3   consisting of polyphenyl ether; elcosyl naphthalene; *i*-diamyl phthalate; *i*-diamyl  
4   sebacate; chlorinated hydrocarbons; *n*-dibutyl phthalate; *n*-dibutyl sebacate; 2-ethyl  
5   hexyl sebacate; 2-ethyl hexyl phthalate; di-2-ethyl-hexyl sebacate; tri-*m*-cresyl  
6   phosphate; tri-*p*-cresyl phosphate; and *o*-dibenzyl sebacate.
- 1           74.    The tubular structure of claim 62 wherein said gaseous deposition  
2   product comprises a siloxane.



- 1           75.     The tubular structure of claim 64 wherein said siloxane is  
2 polydimethyl siloxane.
- 1           76.     The tubular structure of claim 64 wherein said siloxane is pentaphenyl-  
2 trimethyl siloxane.
- 1           77.     The tubular structure of claim 64 wherein said siloxane is a silicon  
2 containing diffusion pump fluid.
- 1           78.     The tubular structure of claim 62 wherein a gaseous precursor to said  
2 gaseous deposition product comprises a metallic precursor.
- 1           79.     The tubular structure of claim 78 wherein said metallic precursor is  
2 selected from the group consisting of metal carbonyls, metal acetates, and metal  
3 alkanedionates.
- 1           80.     The tubular structure of claim 79 wherein said metallic precursor is  
2 metal pentanedionate.
- 1           81.     The tubular structure of claim 79 wherein said metallic precursor is  
2 selected from the group consisting of tetrakis(dimethylamino)titanium, chromium  
3 carbonyls (hexacarbonylchromium), vanadium carbonyls (hexacarbonylvandium  
4 carbonyl).
- 1           82.     The tubular structure of claim 81 wherein said hexacarbonylvandium  
2 carbonyl is selected from the group consisting of erbium III acetate, yttrium 2,4-  
3 pentanedionate, erbium 2,4-pentanedionate, and N,N-(dimethylethanamine)-  
4 trihydridoaluminum.
- 1           83.     The tubular structure of claim 62 wherein said gaseous deposition  
2 product comprises silane.

- 1           84.    The tubular structure of claim 62 wherein said gaseous deposition  
2   product comprises trimethyl silane.
- 1           85.    The tubular structure of claim 64 wherein said coating thickness  
2   comprises a uniformity of about +/- 20% or less along its length.
- 1           86.    The tubular structure of claim 65 wherein said coating thickness  
2   comprises a uniformity of about +/- 20% or less along its length.
- 1           87.    The tubular structure of claim 66 wherein said coating thickness  
2   comprises a uniformity of about +/- 20% or less along its length.
- 1           88.    The tubular structure of claim 67 wherein said coating thickness  
2   comprises a uniformity of about +/- 20% or less along its length.
- 1           89.    The tubular structure of claim 85 wherein said coating comprises a  
2   nanohardness of about 15 GPa measured using a nano-indentation hardness tester.
- 1           90.    The tubular structure of claim 86 wherein said coating comprises a  
2   nanohardness of about 15 GPa measured using a nano-indentation hardness tester.
- 1           91.    The tubular structure of claim 87 wherein said coating comprises a  
2   nanohardness of about 15 GPa measured using a nano-indentation hardness tester.
- 1           92.    The tubular structure of claim 88 wherein said coating comprises a  
2   nanohardness of about 15 GPa measured using a nano-indentation hardness tester.
- 1           93.    The tubular structure of claim 85 wherein said coating comprises a  
2   hydrogen concentration of about 32 %.
- 1           94.    The tubular structure of claim 86 wherein said coating comprises a  
2   hydrogen concentration of about 32 %.
- 1           95.    The tubular structure of claim 87 wherein said coating comprises a  
2   hydrogen concentration of about 32 %.

- 1 96. The tubular structure of claim 88 wherein said coating comprises a
- 2 hydrogen concentration of about 32 %.